THE BIRTHPLACE OF NORTH ATLANTIC TROPICAL STORMS

WILLIAM H. HAGGARD

Office of Climatology, U. S. Weather Bureau, Washington, D. C.
[Manuscript received June 19, 1958; revised August 29, 1958]

ABSTRACT

Newly adjusted tracks of North Atlantic hurricanes and tropical storms for 72 years provide a consistent set of data for examining the birthplaces of these storms. For 59 years (1899–1957) of the record, portions of the adjusted storm tracks from the point of origin of first closed circulation to the point of first hurricane intensity are presented. The origins show a regular seasonal shift eastward and later westward across an area east of the Lesser Antilles. The location of the seasonal maximum of origins in this area is thus explained. The data support Mitchell's conclusion that the eastern Caribbean is not a birthplace of tropical storms. The results are discussed in relation to the available observational network in the hurricane breeding grounds.

1. INTRODUCTION

Forecasters frequently search climatological records for clues to probable weather events at the present or in the immediate future. The climatological records of tropical storm behavior are no exception to the search but one encounters difficulties if he does not examine the records carefully. Among the climatological aids suggested are some that relate storm motions to the season and origin. Yet the origins are often quite uncertain.

The birthplace of any particular tropical storm is difficult to locate with even a reasonable degree of accuracy. Riehl [9] pointed out that tropical storms form in pre-existing disturbances, waves, or shear lines, and that deepening may be a slow process requiring days, or it may be explosive.

The literature contains conflicting statements about the birthplaces of even such important storms as hurricane Connie of 1955 and the New England hurricane of September 1938. Namias and C. Dunn [7], in discussing the formation of hurricane Connie, stated: "While hurricane Connie was first reported on August 4 at about 16.6° N. and 48.0° W., there is some indication that it developed off North Africa some time earlier." Authors have variously put the birthplace of the September 1938 storm at longitudes 68° W., 50° W., 37° W., and 5° W. Hubert [5] traced a storm circulation, which developed into the devastating New England hurricane, from a point over West Africa at 5° W. on September 7, 1938. Brooks [1] discussed several versions of this track; figure 1 is from his paper. Pierce [8] stated: "The actual history of the storm goes back to some time before September 13th, when it was noticeable in the region of the Cape Verde Islands." Tannehill [10] said of this storm shortly after its occurrence: "There was some evidence of cyclonic circulation central about 19° N., 37° W., on the morning of September 13, 1938 . . . ." Later, Tannehill [11] commented: "There are some indications that this hurricane originated near the Cape Verde Islands . . . ."

Previous investigators have tried to establish the birthplaces of North Atlantic tropical storms and hurricanes. Mitchell's [6] classic work on West Indian hurricanes was, in his words, "prompted by the results of a more restricted investigation—namely, an examination by the author of the idea, long held by him, that West Indian hurricanes *never* originate over the eastern two-thirds, approximately, of the Caribbean Sea . . . . The results of this investigation proved so interesting and informative that the more comprehensive work of replotting the tracks of all tropical storms that originated over the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico during the entire period for which daily charts of the North Atlantic are available, 1887 to date [1924], was undertaken." Tannehill included a chapter on the "Origin of West Indian Hurricanes" in his text [11] and used the intersections of the tracks of storms from different areas as an indication of place of origin.

Dunn [2] in discussing areas of hurricane development stated: "Obviously this area is not a point, yet the concept is meaningless if it is expanded to encompass the entire known existence of the wave prior to the attainment of hurricane intensity." He did not attempt to define the "area of development," but for all storms from 1901 to 1955 located that point on each hurricane track where the storm first reached hurricane intensity.

2. ESTABLISHMENT OF TRACKS

In the present investigation the tracks of all North Atlantic hurricanes or tropical storms known to have occurred from 1886 through 1957 were examined in the Marine Section, Office of Climatology, U. S. Weather Bureau [13]. The extensive work done earlier by Mitchell [6], Tannehill [11], Fassig [4], and Tingley [12] was reviewed and all charts and articles in the several issues of the *Monthly Weather Review* for these years were studied. A set of revised annual track charts based on all these sources was prepared. As a result of reviews by person-

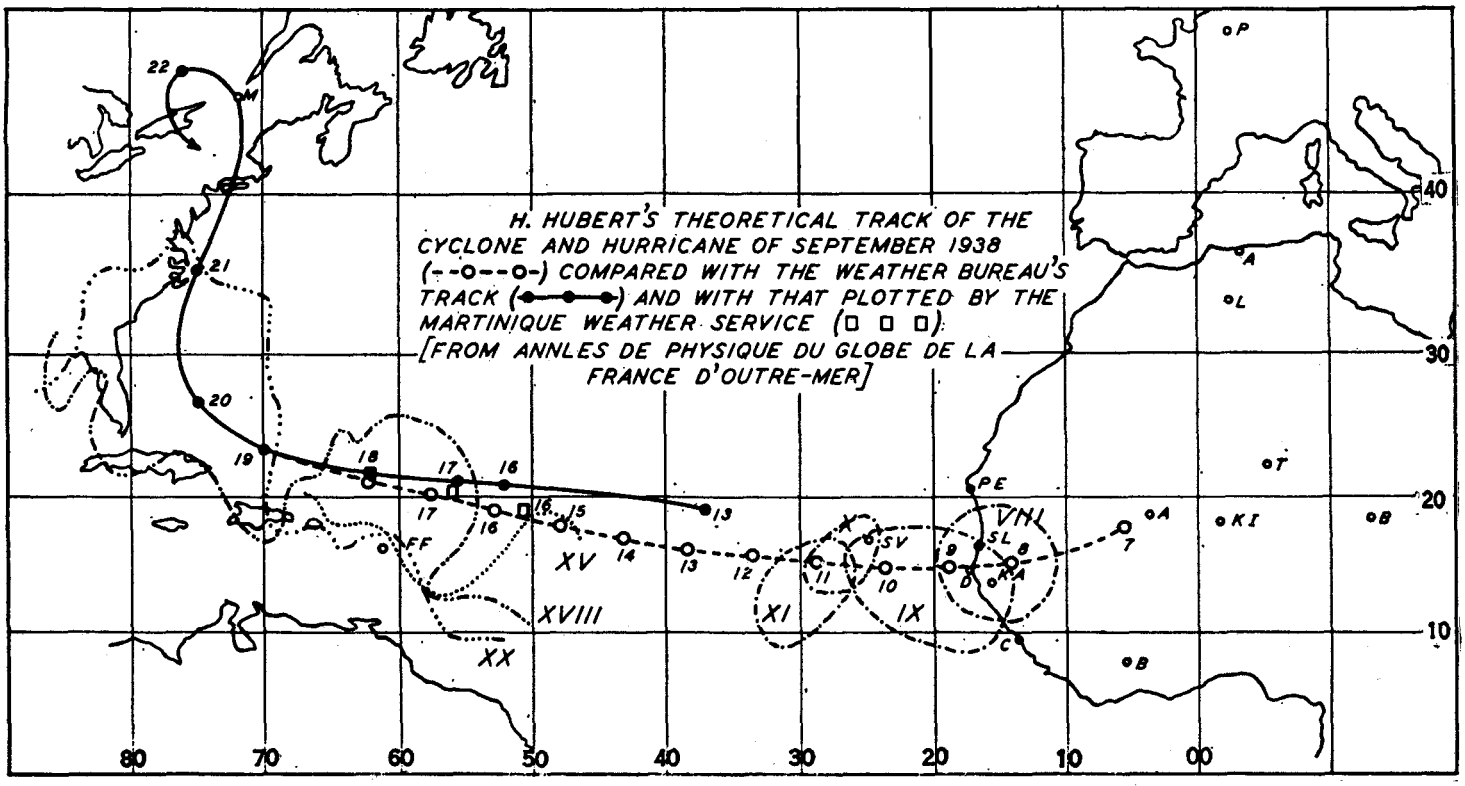

FIGURE 1.—Versions of the track of the New England Hurricane of September 1938. (After Brooks [1]). Positions of 1015-mb. isobar are shown by light broken lines and dates indicated by Roman numerals; Weather Bureau's version of track from September 20 to 22 was revised by Pierce [8] who placed track on 73d meridian from Cape Hatteras to southern Vermont.

nel of the Weather Bureau's Extended Forecast Section, Hydrometeorological Section, National Hurricane Research Project, and hurricane forecast offices in Miami, San Juan, and New Orleans, many adjustments of the tracks were made. Mutual adjustments between these charts and those developed by Dunn were necessary in the tracks and the points where hurricane intensity was first reached.

For the years 1899 through 1957, an effort was made to separate the tracks into portions according to the current intensity of the storm. The exact point in its track at which a storm attained tropical storm intensity is naturally somewhat questionable. The point of origin of the storm circulation, sometimes subjectively determined, represents a best estimate of the location of the first closed circulation that could be tracked to the area where later a storm of tropical storm or hurricane intensity is believed to have been. The individual tracks may not provide a true representation of what occurred in Nature, but they were drawn with a consistent set of considerations throughout the period.

3. REGIONS OF ORIGIN

A schematic portrayal of track origin areas, or regions of development, was included in an article compiled by Office of Climatology of the U. S. Weather Bureau [14]. Examination of the monthly charts of the frequency of track origins by 2½° areas, published in that article, shows the well known seasonal shift in the main area of origin from the western Caribbean and Yucatan in June eastward to the Bahamas and even to Cape Verde in mid-season and then gradually back to the western Caribbean by November. Although in that article the breakdown is by months, it is consistent with the information published by Dunn [3] regarding region of origin and season.

The large maximum of origins east of the Lesser Antilles was at first believed to be a fiction resulting from the easier detection of storms affecting the dense net of observing stations in this island chain. Further study of storm origins has, however, modified this belief.

Figures 2 through 10 show in a somewhat different fashion the origin points of North Atlantic tropical storms and hurricanes. The portion of the storm track shown is from its earliest known, or suspected, point of closed circulation (open circle) to the point of hurricane intensity (solid circle). If the storm did not reach hurricane intensity, the birthplace is shown as an open circle with no track. The numeral within the circle represents the year in which the storm occurred.

As shown in figure 2, all June developments in the past 59 years were in the Gulf of Mexico or the western Caribbean, with the exception of three storms, one at low latitudes in the Atlantic and two in the Bahamas. No

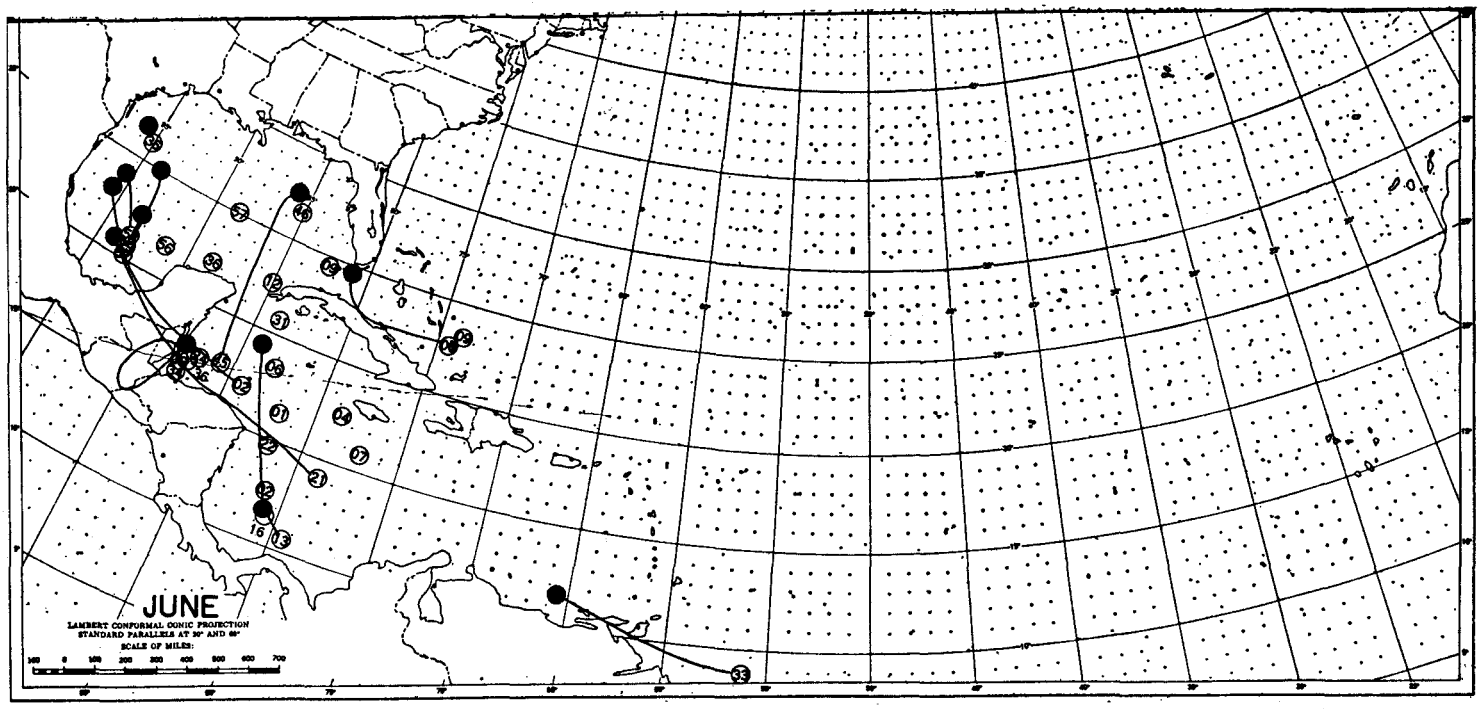

FIGURE 2.—Areas of storm development for June, 1899–1957. Open circle shows area of origin; solid circle, start of hurricane stage.

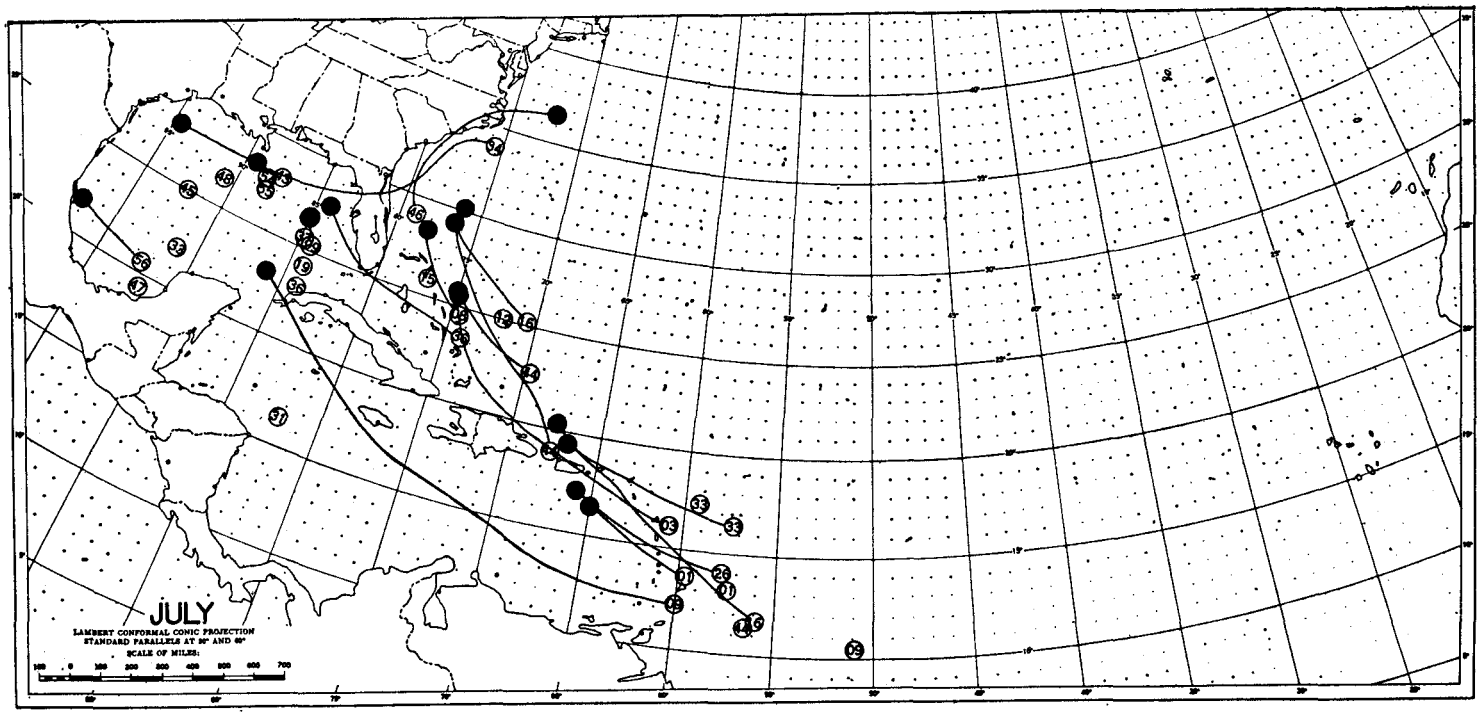

FIGURE 3.—Areas of storm development for July, 1899–1957.

birthplaces were detected east of 55° W. Tropical storms outnumbered hurricanes.

For July (fig. 3), the principal breeding ground shifted away from the western Caribbean. Tropical storms and a few hurricanes originated in the Gulf. The activity was greater than that of June in the Bahamas area and the region east of the Lesser Antilles. In July no birthplaces were detected east of 50° W.; the July origins were, however, well east of the June ones.

For early August (fig. 4), there were fewer origins in the Gulf. Most storms developed in the area just east of the West Indies and several originated (at about latitude 15°) over the Atlantic.

In the latter half of August (fig. 5), the main concentration of development was in the strip from the Bahamas southeastward to 15° N., 50° W., thence between 10° N. and 15° N. eastward to Africa. A large percentage of these storms reached hurricane intensity after only a very short travel over tropical waters.

For the first half of September (fig. 6) more storm

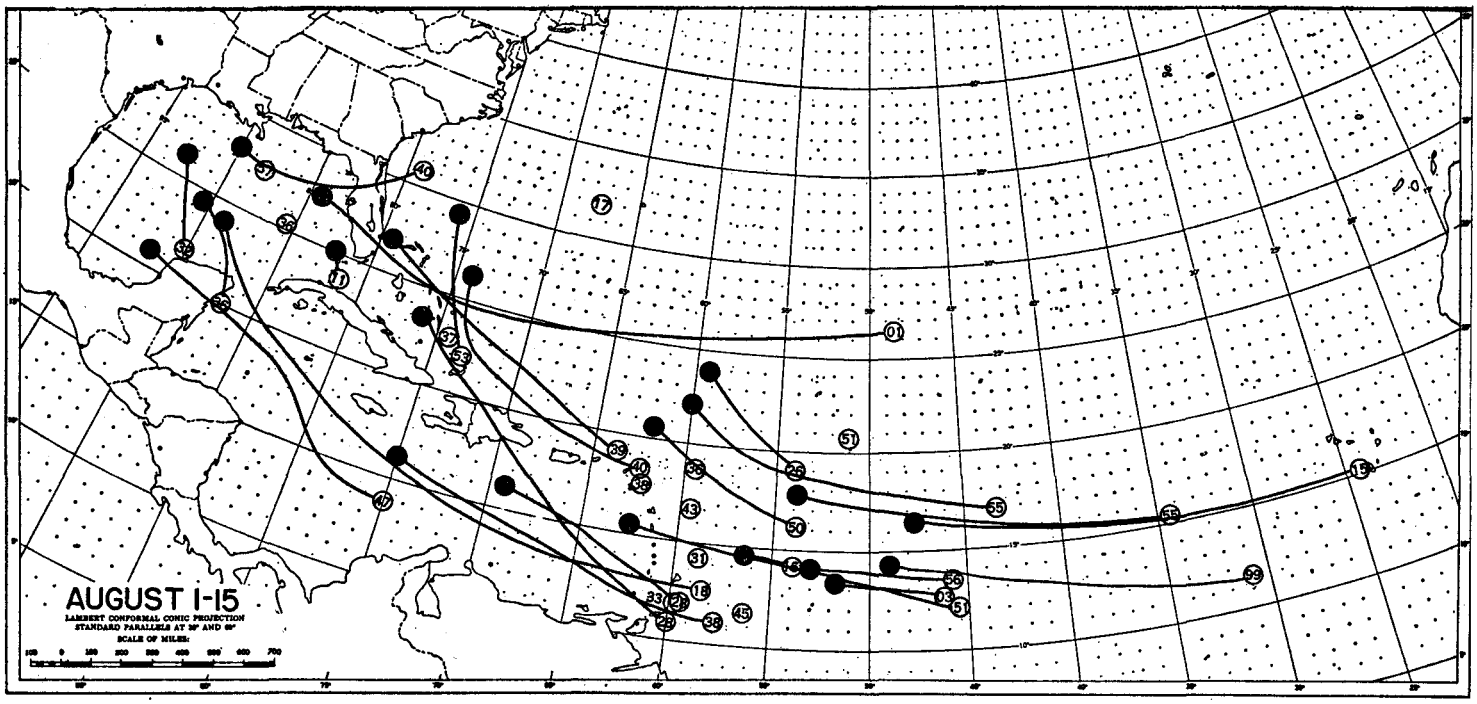

FIGURE 4.—Areas of storm development for August 1–15, 1899–1957.

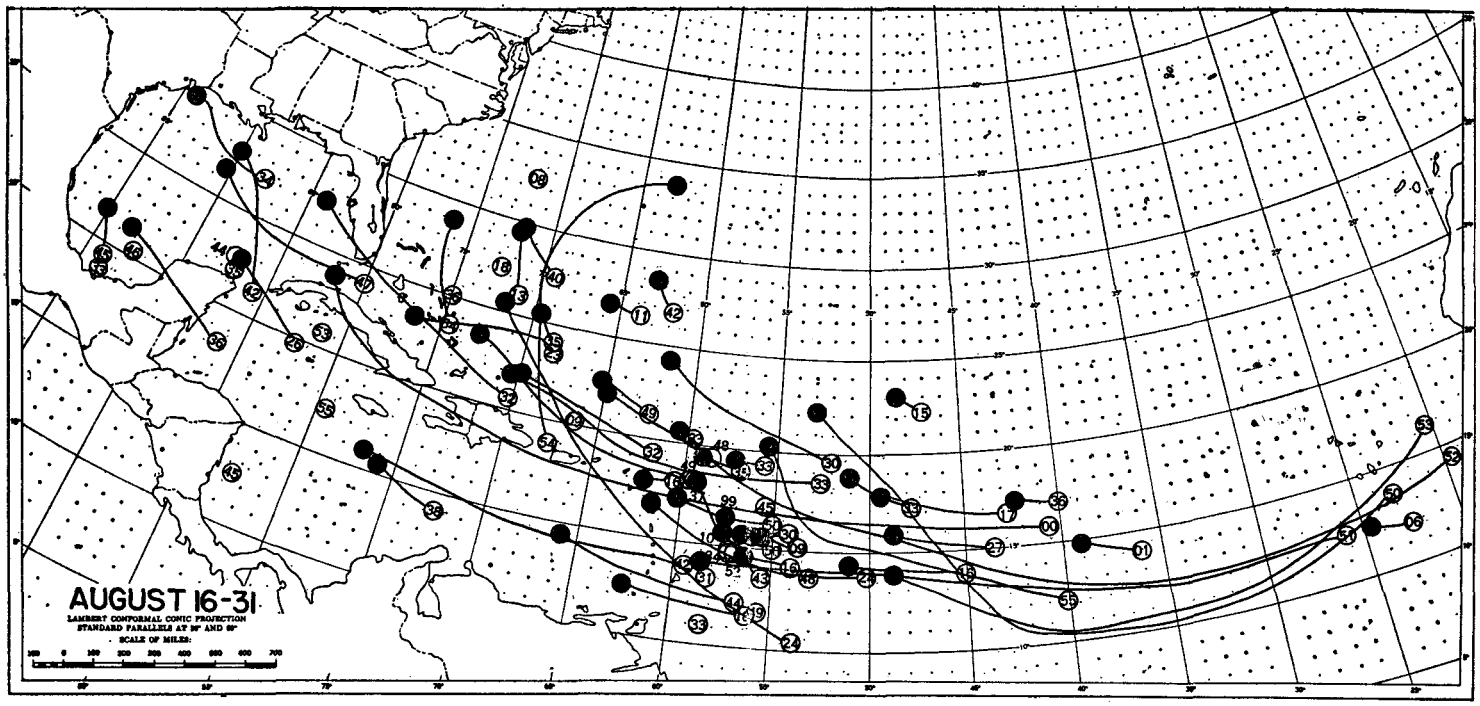

FIGURE 5.—Areas of storm development for August 16–31, 1899–1957.

originated in low latitudes over the eastern Atlantic, and again the development stages were frequently quite short. A number of storms which attained only tropical storm intensity developed in the southern Gulf, and quite a few circulations started at approximately 55° W., with a considerable northward component to their motion during development.

In the last half of September (fig. 7), with the total number of origins decreased, no storms developed so far east as in the early part of the month, and more storms formed at higher latitudes over the western part of the ocean. Developments were again frequent in the western Caribbean and southern Gulf areas, but much less frequent in the area just to the east of the Antilles than in the previous 30 days.

In early October (fig. 8), the densest concentration of

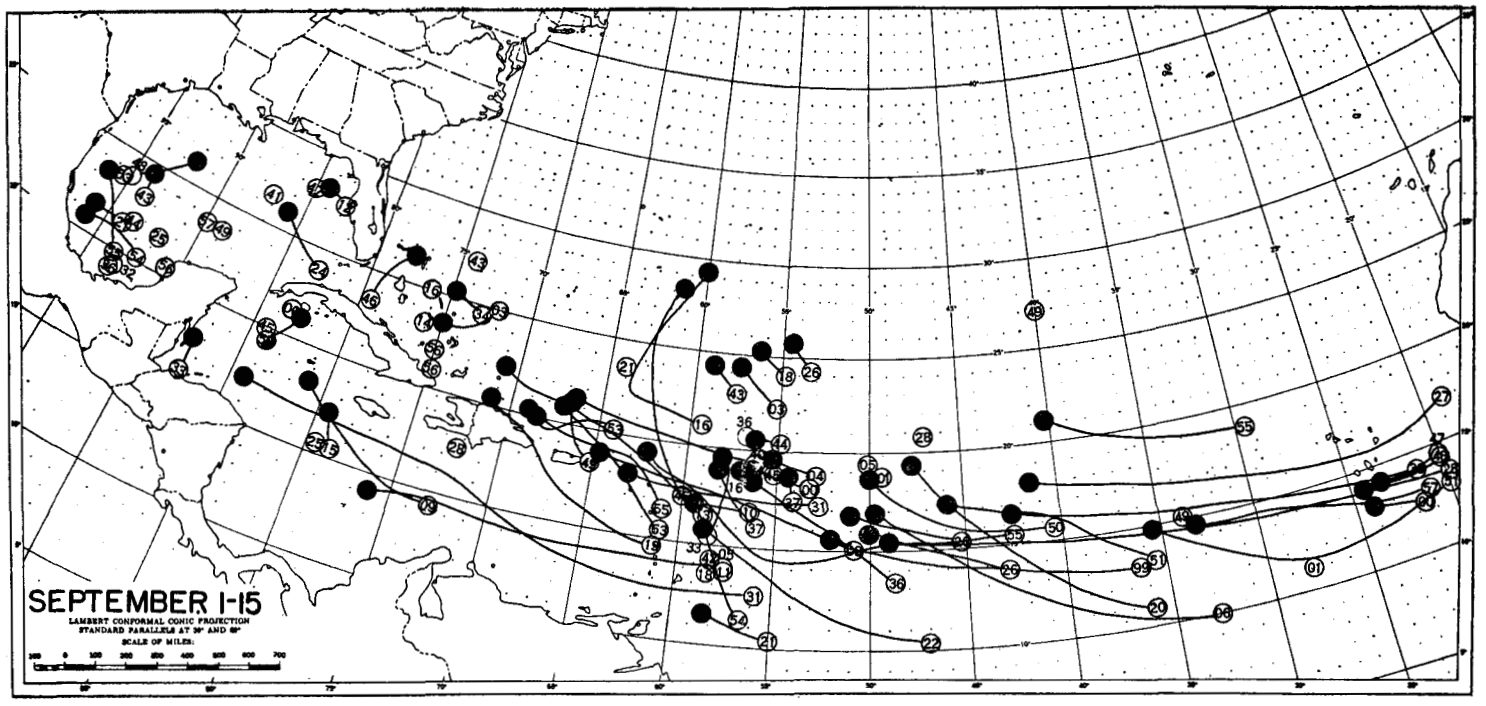

FIGURE 6.—Areas of storm development for September 1–15, 1899–1957.

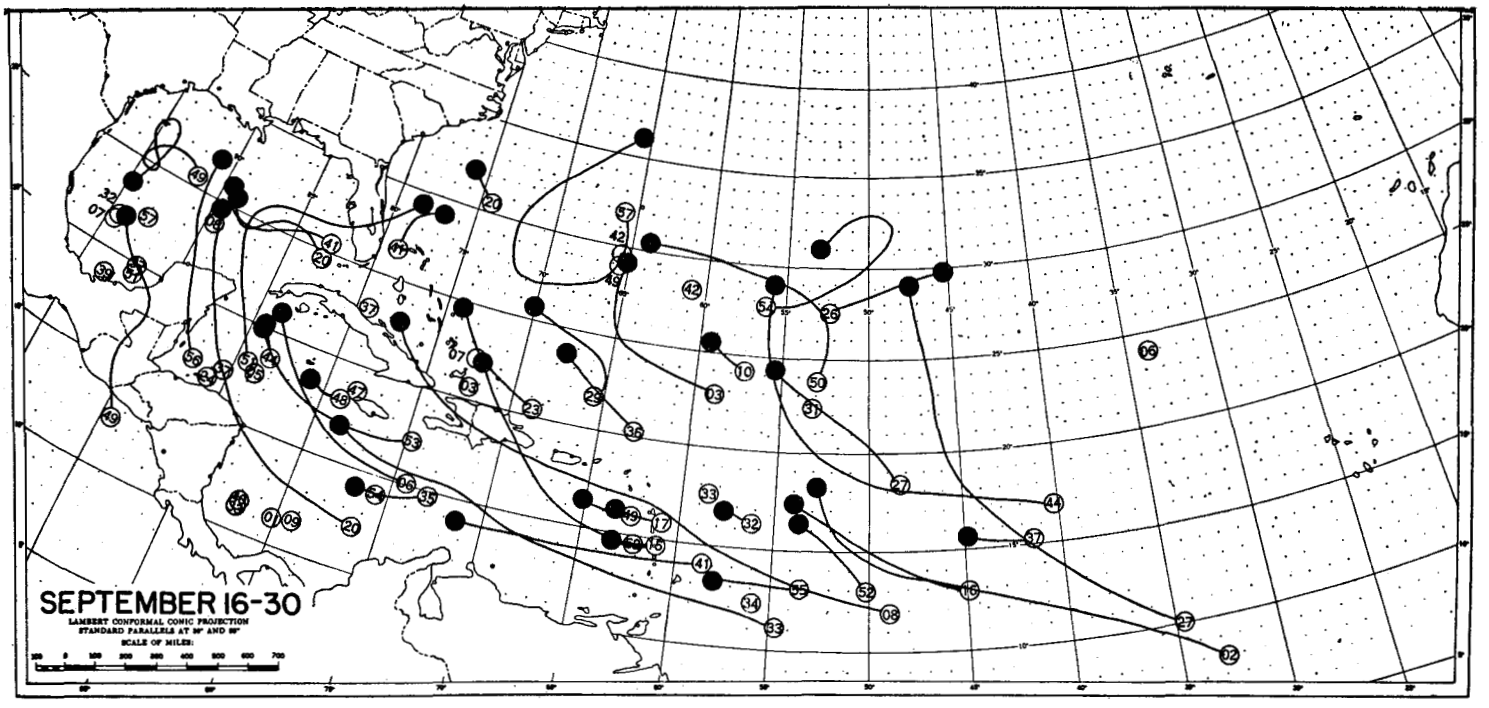

FIGURE 7.—Areas of storm development for September 16–30, 1899–1957.

origins was in the western Caribbean. Developments over the Atlantic were spread over a broad region west of 35° W. and ranging from 11° to 30° N., with one tropical storm in 1913 beginning at 40° N. This storm moved southward and later southwestward to enter the United States coast near Charleston, S. C. A few storms developed in the lesser Antilles and two which had their birthplace in the eastern North Pacific crossed the Central American Isthmus to enter the Gulf of Mexico.

For the latter half of October (fig. 9), storm activity, greatly reduced in all areas, was mainly in the western Caribbean-Yucatan area. Several tropical storms were spawned over the western Atlantic between 20° N. and 30° N. and two, in 59 years, originated in the Gulf.

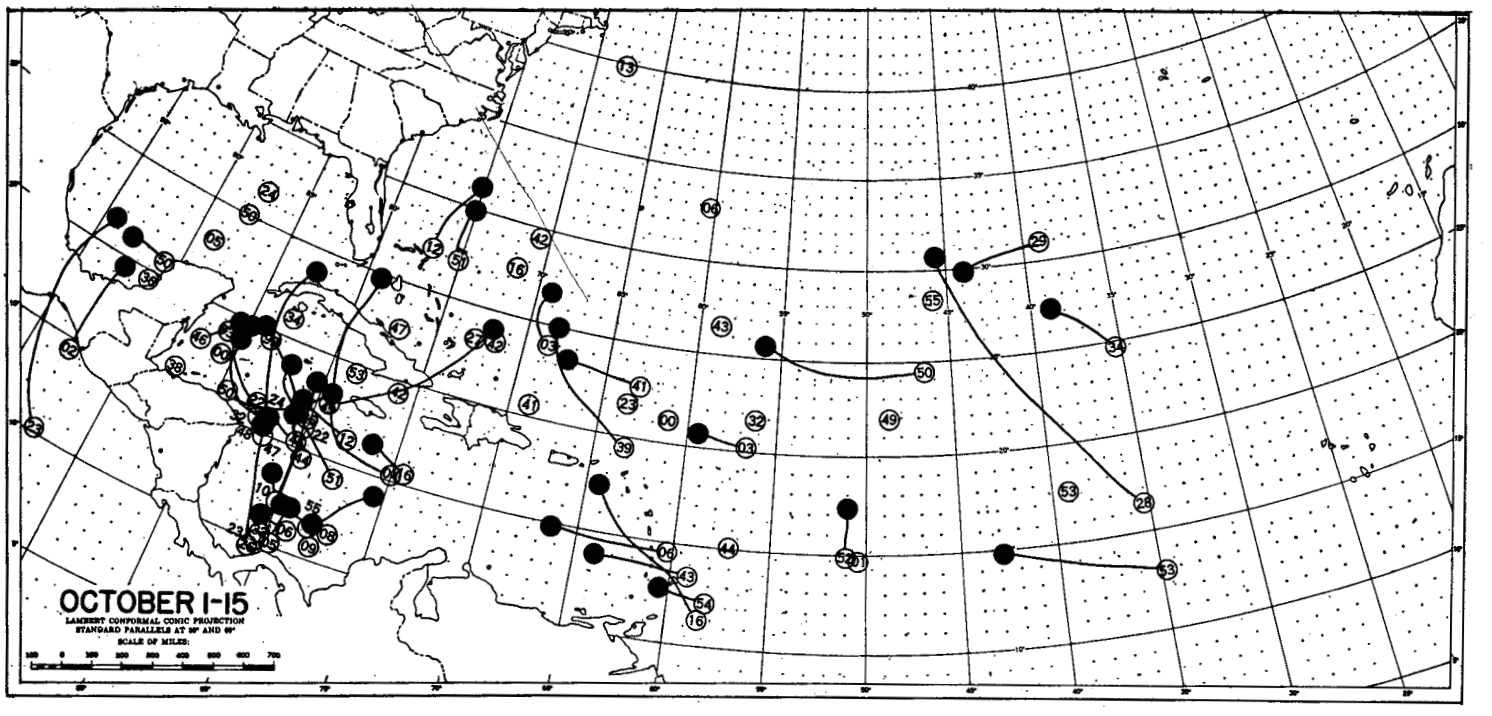

FIGURE 8.—Areas of storm development for October 1–15, 1899–1957.

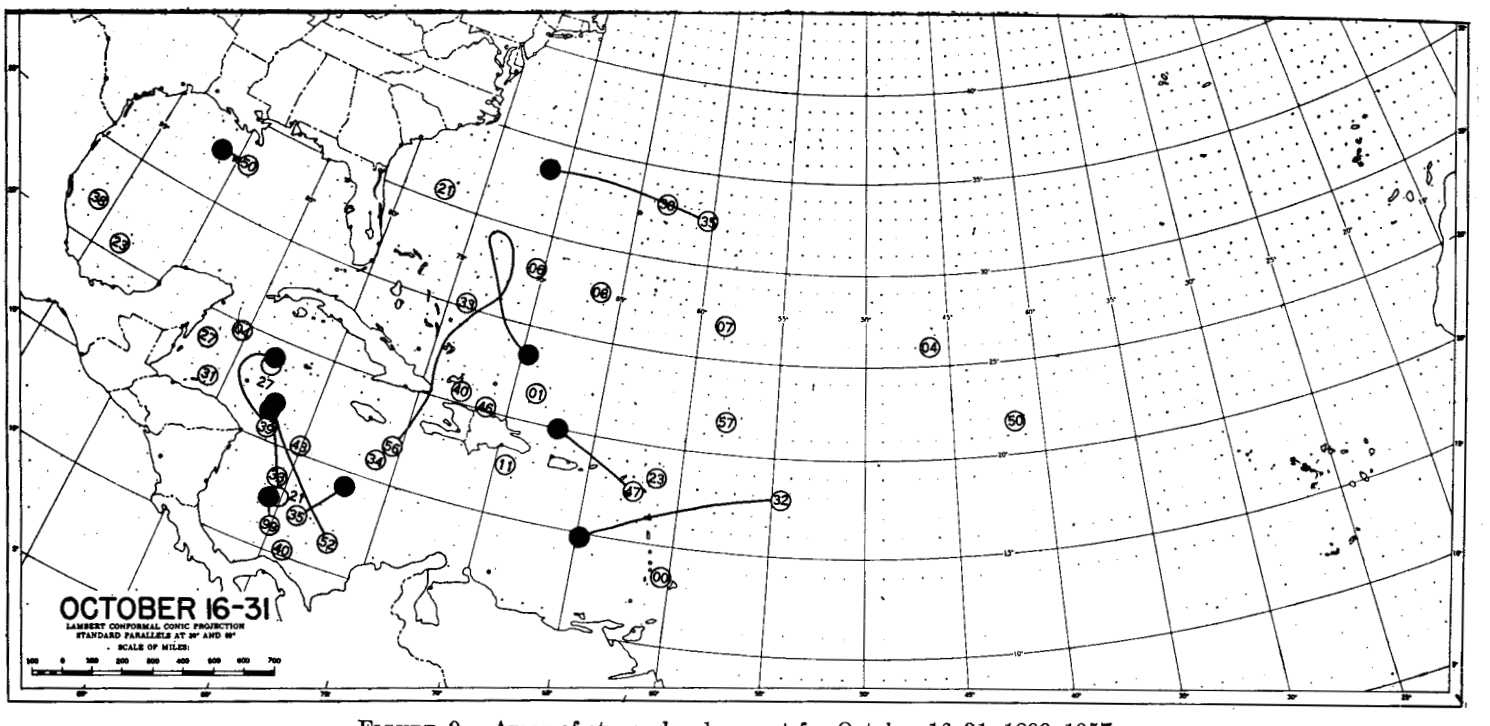

FIGURE 9.—Areas of storm development for October 16–31, 1899–1957.

For the colder months November through May (fig. 10), origins in this period were scattered over the ocean area northeast of the West Indies and in a concentrated area over the western Caribbean.

4. SUMMARY

The familiar shift from the western Caribbean in June gradually eastward in July and early August to the zone extending across the Atlantic in September and back again to the western Caribbean in the late season is obvious. A few early-season and many September storms have originated over the Gulf of Mexico.

The seasonal maximum of origins east of the lesser Antilles may be real, and not, as had previously been

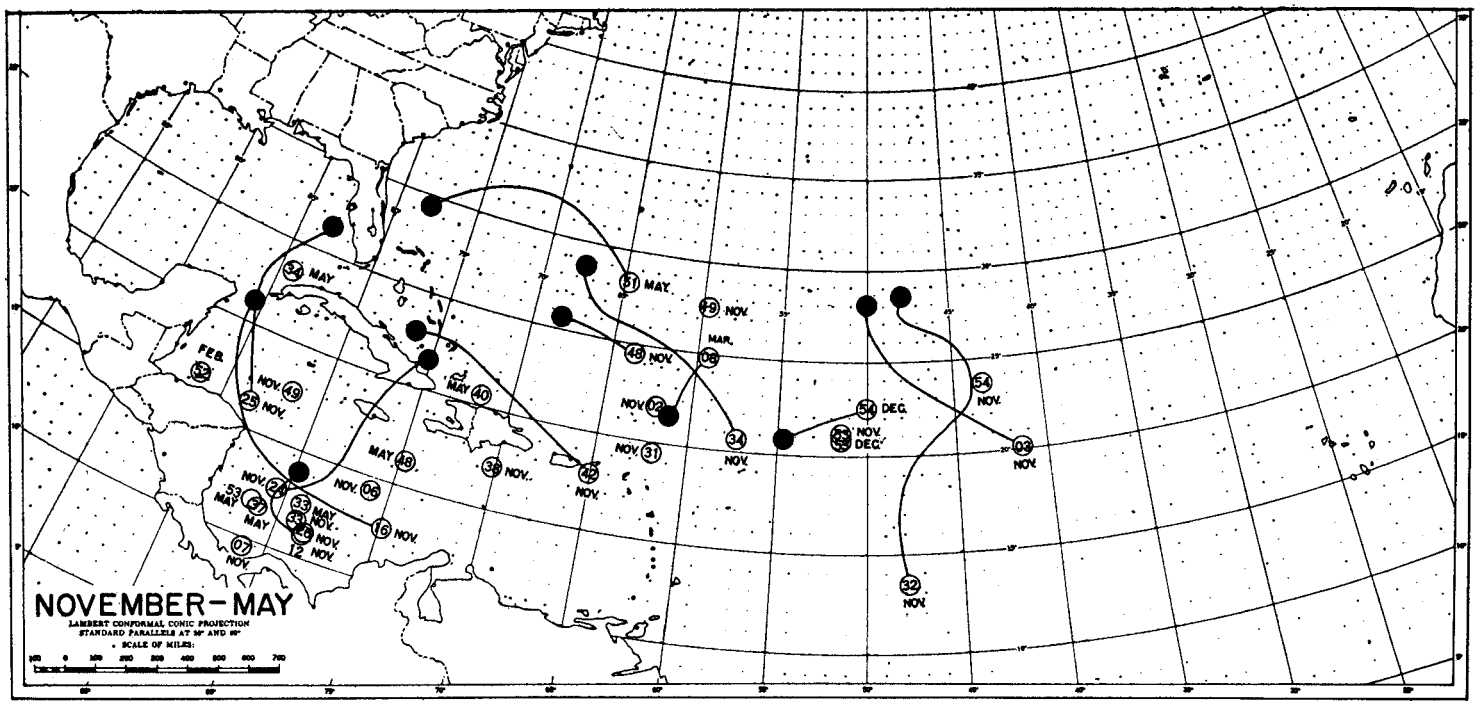

FIGURE 10.—Areas of storm development for November–May, 1899–1957.

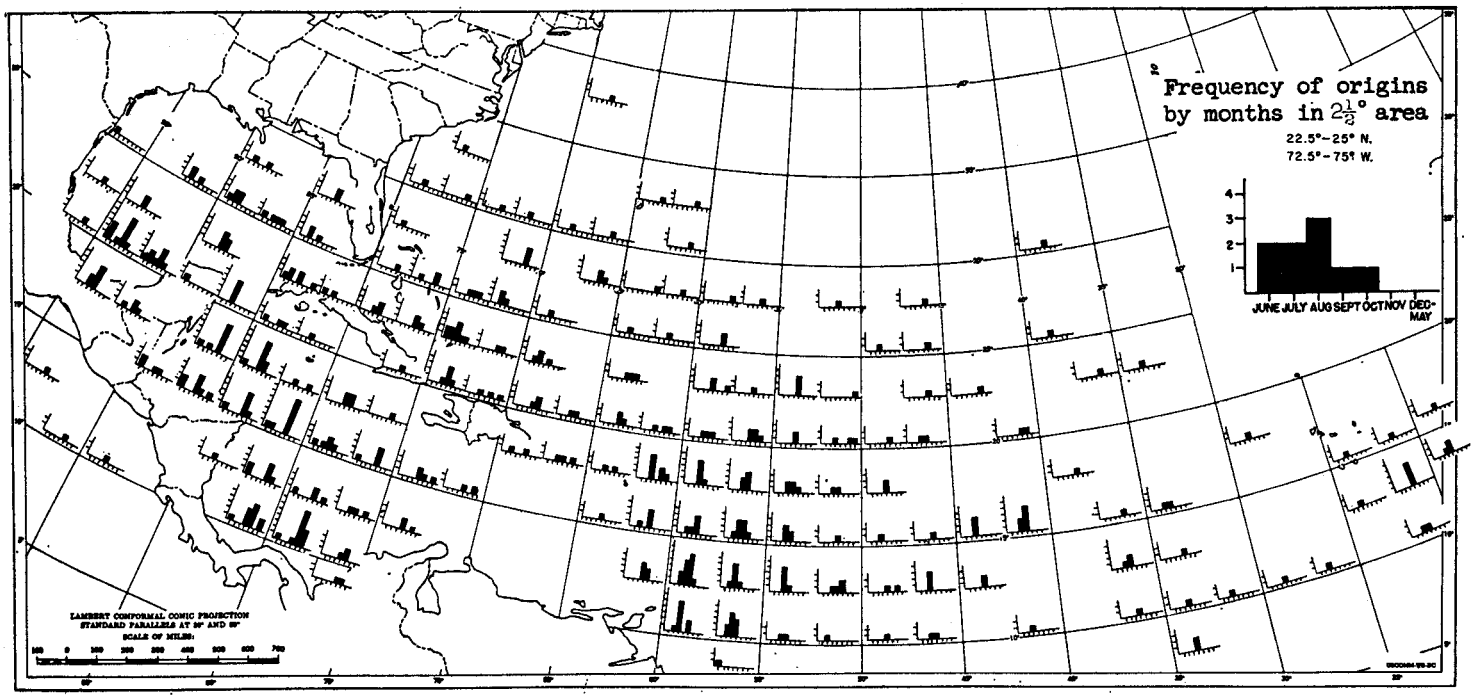

FIGURE 11.—Frequency of storm origins by months within 2½° areas (1899–1957).

believed, the accidental result of a denser net of observational points. The regular shift eastward and later westward through this region may explain the large maximum found here.

Figure 11 summarizes the origin data of figures 2–10 and shows schematically by months the frequency of storm origins over the North Atlantic, the Caribbean, and the Gulf of Mexico. This chart appears to support the conclusions of Mitchell [6] that the eastern Caribbean is not a birthplace of such storms.

Many of the tropical storms and hurricanes that have affected the United States had their beginning in areas where a minimum of meteorological observations have been available. The eastern Atlantic, the western Caribbean,

and especially the southern Gulf of Mexico are virtual data voids. Yet they are the hurricane breeding grounds.

During the 1958 season the Bureau of Aeronautics, U. S. Navy, scheduled an experiment with an automatic marine weather observing station and several moored buoys in the mid-Gulf of Mexico. Such experiments may make it possible to obtain observations in the future from these vitally important areas where data are so scarce. The temporary network of the National Hurricane Research Project has filled a few gaps in the observing network, particularly in the western Caribbean. Certainly continuance of these observing stations would appear desirable. Meanwhile, it may be appropriate to consider the use of such climatological data as are presented here, together with existing long-wave patterns, for the scheduling of reconnaissance flights into different areas according to the probability of storm development in these areas in each portion of the season.

ACKNOWLEDGMENTS

The author is indebted to: Dr. H. E. Landsberg for fostering interest in and providing guidance during this study; to Mr. Robert Simpson for the support and encouragement provided by the National Hurricane Research Project; to Messrs. G. Dunn, S. Lichtblau, R. Higgs, and R. Schmidt for helpful comments leading to revision of many of the tracks; to Mr. J. Namias and Dr. C. Gilman for the helpful coordination provided by members of their staffs in the Extended Forecast and Hydrometeorological Sections, respectively, particularly Messrs. E. M. Ballenzweig and V. Myers; and to Messrs. H. White and G. Cry for many hours of work on the revision of the tropical storm tracks and the development of the figures used in this presentation.

REFERENCES

1. C. F. Brooks, "Hubert on the African Origin of the Hurricane of September, 1938," *Transactions of the American Geophysical Union*, 21st Annual Meeting, Part II, April 1940, pp. 251–253.
2. G. E. Dunn, "Areas of Hurricane Development," *Monthly Weather Review*, vol. 84, No. 2, Feb. 1956, pp. 47–51.
3. G. E. Dunn, "Tropical Cyclones," *Compendium of Meteorology*, American Meteorological Society, Boston, Mass., 1951, pp. 887–901.
4. O. L. Fassig, "Hurricanes of the West Indies," *Bulletin X*, U. S. Weather Bureau, Washington, D. C., 1913, 28 pp. and 25 plates.
5. H. Hubert, "Origine Africaine d'un Cyclone Tropical Atlantique," *Annales Physique du Globe de la France d'Outre-Mer*, vol. 6, 1939, pp. 97–115.
6. C. L. Mitchell, "West Indian Hurricanes and Other Tropical Cyclones of the North Atlantic Ocean," *Monthly Weather Review Supplement* No. 24, Washington, 1924, 47 pp.
7. J. Namias and C. R. Dunn, "The Weather and Circulation of August 1955—Including the Climatological Background for Hurricanes Connie and Diane," *Monthly Weather Review*, vol. 83, No. 8, Aug. 1955, pp. 163–170.
8. C. H. Pierce, "The Meteorological History of the New England Hurricane of Sept. 21, 1938," *Monthly Weather Review*, vol. 67, No. 8, Aug. 1939, pp. 237–285.
9. H. Riehl, *Tropical Meteorology*, McGraw-Hill Book Co., Inc., New York, N. Y., 1954, 392 pp.
10. I. R. Tannehill, "Hurricane of September 16 to 22, 1938," *Monthly Weather Review*, vol. 66, No. 9, Sept. 1938, pp. 286–288.
11. I. R. Tannehill, *Hurricanes*, 9th Rev. Ed., Princeton University Press, 1956, 308 pp.
12. F. G. Tingley, charts and notes on West Indies hurricanes, 1887–1930, unpublished, U. S. Weather Bureau, 1930.
13. U. S. Weather Bureau, "North Atlantic Hurricanes and Tropical Storms, 1886–1957," *Technical Paper* No. 35, Washington, D. C. (to be published, 1959).
14. U. S. Weather Bureau, "West Indian Hurricanes," *Mariners Weather Log*, vol. 1, No. 4, July 1957, pp. 73–83.